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GLASS AND METAL CRYOSTAT FOR COOLED INFRARED RADIATION DETECTOR--ETC(U)
MAY 79 T PIOTROWSKI
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by

Tadeusz Piotrowski

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Glass and Metal Cryostat for Cooled Infrared Radiation Detectors

Tadeusz Piotrowski

Presently in this day of the rapid development of infrared technology and laser technology there exists a great need for cooled infrared radiation detectors having adequate service parameters.

The qualities of the cryostat, being an integral part of the detector, determine these parameters beyond the detection qualities of a sensitive element. The cryostat serves to ensure the proper temperature of operation of the sensitive element (1) and is the housing which satisfies a series of its functions. At the Warsaw Polytechnic Institute of Electronic Technology a cryostat structure, type 306, has been developed which operates with sensitive elements which require cooling to the temperature of liquid nitrogen. A diagram of the cryostat is shown in the drawing.

The type 306 cryostat is composed of a glass Dewar vessel 1, enclosed in a metal casing 2. The upper, wider part of the Dewar vessel, contains the principle receptacle for the liquid nitrogen 3, while the lower part is the base of the sensitive element 4 and the electrical supply together with vacuum-tight seal wires 5. The vessel's shape with variable diameters allows such a choice of the place of air-tight sealing as to prevent the possibility of damaging the sensitive elements which are not resistant to increased tempera-

ture which takes place during the soldering of the glass (in the case of $Cd_{0.2} Hg_{0.8} Te$ the temperature should not be lower than 70° C).

The walls of the Dewar vessel are covered from the side of the vacuum area 6 by a layer of material having a small emission factor, e.g., chemically applied gold or aluminum. The thermal insulation material 7 in the form of styrofoam shapes fills the space between the glass part of the cryostat and the metal casing.

The cryostat casing is a steel cylinder closed by two covers. In the upper cover 8 there is a tapped hole, delivering the liquid nitrogen, closed by a cover 9, which is provided to the ventilating channel 10, which allows automatic elimination of nitrogen vapor from the cryostat. In the lower cover 11 there is an opening 12, through which the infrared radiation after passing through the window 17 gets through to the sensitive element. The window 17 is made from silicon with a decreased deflection factor. The possibility is provided to place in the opening 12 a germanium filter which eliminates the effect of radiation diffusion in a visible range and of close infrared radiation. Electrical contacts of the sensitive layer are across the vacuum-tight seal wires connected with the BNC socket 13 placed in the wall of the side casing. The steel casing 2 fulfills the role of a screen which decreases the effect of external interferences on the detector signal. The handle 14 mounted to the casing serves to set up the cryostat on an optical bench. The cryostat operates

only in an upright position, connected with which is the fact that the radiation is supplied to the sensitive layer straight from the bottom. An additional piece of equipment of the cryostat is an attachment 15 which contains a mirror 16 situated at a 45^{o} angle relative to the axis of symetry of the attachment. It enables an analysis of the radiation on the level of the direction of its propagation and allows the choice of this direction.

In the completed samples of the cryostats there are placed photoconducting thin layers of $Cd_x Hg_{1-x} Te$ (x=0.2) serving to detect CO_2 laser radiation (2). The sensitivity layer, infused on the base with mica is fastened to the lower part of the Dewar vessel by resins having great thermal conductivity and corresponding value of the coefficient of expansion. The following values of service parameters were obtained:

- tank capacity of liquid nitrogen $V = 200\ cm^3$,
- continuous running time at lowered temperature $t=5-8$ hrs.,
- detector angle of view $\alpha = 60^{o}$.

The rather long period attained of maintaining the coolant permits the use of the detector in laboratory technology and in many other applications.

These cryostats are universal; thin layered and photoconducting and photovoltaic lithium elements made of various materials can be mounted in them. In the case of a change in the operational spectral range in this type of

cryostat it is possible to use other windows for infrared radiation.

The basic feature of cryostats having an all-glass Dewar vessel is their vacuum-tightness which does not require periodic regeneration, pumping out and use of zeolites or getters. This is the principle feature differentiating them from vacuum-tight structures using vacuum grease (3), including all-metal structures. This quality is very essential since in the case of a detector requiring periodic regenerations detection parameters are a function of time, which makes it impossible to use it for standard measurements and limits use for all purposes and decreases convenience of service. The cryostats described, with respect to good service qualities, relatively low production cost and possibility of modifying several structural characteristics, found use in cooled infrared radiation detectors produced in this country.

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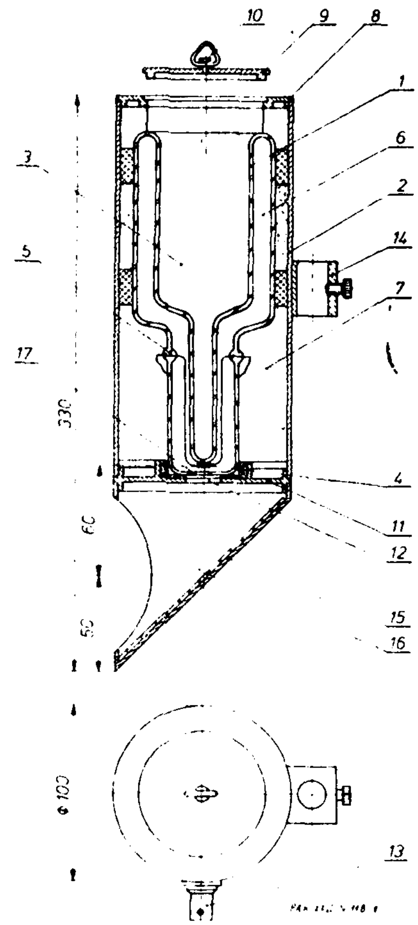

Diagram of cryostat.

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